Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2013

Subject code: 710405N **Date: 18-06-2013**

Subject Name: Fiber Optics Communication

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define the following terms: **07**

1. Total internal reflection.
2. Snellôs Law.
3. Critical angle.
4. Acceptance angle.
5. Numerical Aperture.
6. Skew rays.
7. Graded index Fiber.

(b) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47 determine: **07**

1. The critical angle at the core cladding interface.
2. The NA for the fiber.
3. The acceptance angle in air for the fiber.

Q.2 **(a)** A multi mode step index fiber with a core diameter of 80µm.And relative index difference of 1.5% is operating at a wavelength of 0.85 µm. if the core refractive index is 1.48 estimate: **07**

1. Normalized frequency for the fiber
2. The number of guided modes.

(b) A Graded index fiber with a parabolic refractive index profile core has a refractive index at the core axis of 1.5 and relative index difference of 1% estimate the max. possible core diameter which allows a single mode operation of a wavelength of 1.3 µm. **07**

OR

(b) (1)Determine the cut-off wavelength for a step index fiber to exhibit single mode operation when the core refractive index and radius are 1.46 and 4.5 µm respectively, with the relative index being 0.25%. **07**

(2)Define: 1) Intrinsic Absorption.
2) Extrinsic Absorption.

Q.3 **(a)** Explain:1) Rayleigh scattering. **07**
2) Mie scattering.

(b) Silica has an estimated fictive temperature of 1400K with an isothermal compressibility of $7x10^{-11}m^2N^{-1}$ the refractive index and the photo elastic co-efficient for silica are 1.46 and 0.286 respectively. Determine the theoretical attenuation in decibels per kilometer due to fundamental Rayleigh scattering in silica at optical wavelength of 0.63 µm. **07**

(Boltzmannôs constant is $1.381x10^{-23}JK^{-1}$).

OR

Q.3 **(a)** Define material dispersion and derive equation for it. **07**

	(b)	A 6km optical link consists of multimode step index fiber with a core refractive index of 1.5 and a relative index difference of 1% estimate: 1. The delay difference between the slowest and the fastest modes at the fiber output. 2. The rms pulse broadening due to intermodal dispersion on the link.	**07**
Q.4	**(a)**	Draw the schematic diagram of OVPO(Outside Vapor Phase Oxidation)process for the preparation of optical fibers and explain it in detail.	**07**
	(b)	A planner LED is fabricated from gallium arsenide which has a refractive index of 3.6,Then: 1)Calculate the optical power into air as a percentage of the internal optical power for the device when the transmission factor at the crystal-air interface is 0.68. 2)When the optical power generated internally is 50% of the electrical power supplied ,determine the external power efficiency.	**07**
		OR	
Q.4	**(a)**	A planner LED is fabricated from gallium arsenide which has a refractive index of 3.6. The transmission factor at the crystal-air interface is 0.68.The light of output from this LED is coupled into a step index fiber with NA of 0.2 and a core refractive index of 1.4 and diameter larger than the diameter of the device estimate: i)The coupling efficiency into the fiber when the LED is in close proximity to the fiber core. ii)The optical loss in decibels ,relative to the power emitted into LED. When coupling the light output into the fiber. iii)The loss relative to the internally generated optical in the device when the coupling the light output into fiber when there is a small air gap between the LED and the fiber core.	**07**
	(b)	What are the requirements to be satisfied by detector used in optical fiber communication for performance and compatibility?	**07**
Q.5	**(a)**	When $3x10^{11}$ photons each with a wavelength of 0.85µm are incident on a photodiode, on average $1.2x10^{11}$ electrons are connected on the terminal of the device. Determine the quantum efficiency and the responsivity of the photodiode by 0.85 µm.	**07**
	(b)	Draw the structure of a front illuminated and a side illuminated silicon p-i-n photodiode and with necessary diagram explain its working principle.	**07**
		OR	
Q.5	**(a)**	Briefly explain optical time domain reflectometry (OTDR) or the back scatter measurement method with diagram.	**07**
	(b)	Explain the classification of optical fiber couplers with figures.	**07**

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